**Ft. Lewis Sustainability Briefing**
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**(Remote Teleconference)**

# Materials Based Sustainability Improvement Opportunities

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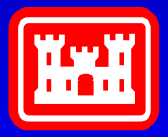


# Materials Based Sustainability Improvement Opportunities

- **Problem:** Need to comply with
  - EO 13101 “Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition”
  - ETL 1110-3-491 “Sustainable Design for Military Facilities”

- **Solution:** Identify site specific, materials based, SIOs and assure at least equal performance to what’s replaced
- **Benefits:**
  - Waste reduction/Increased recycled content
  - Extended service life
  - Reduced net energy use/inputs
  - Reduced water use
  - Reduce cost (LCC)
  - Increase quality of life

# Materials Based Sustainability Improvement Opportunities

- **The List (thus far):**
  - Recycled plastic:  lumber, roofing, rail road ties
  - Structural insulated sandwich panels
  - ”Green” concrete
  - Insulating additives for paint
  - Soy based polymer resins
  - Synthetic wood (using biofibers)
  - Plant fiber reinforcing for composites and concrete
  - Recycled Carpeting / Spray polymer carpeting
  - RASTRA
  - Basalt fiber reinforcement for composites
  - Barnacle cement and glue
  - Silk hybrid polymers

# SUSTAINABLE MATERIALS & SYSTEMS

## What Is Sustainable?

- Durable -- Long Lasting
- Low / Benign Environmental Impac
  - Toxicity
  - Energy
  - Efficient Use Of Natural Resources
- Use Recovered / Recycled Resourc

Waste plastic containers

Recycled-plastic lumber bridge at Ft. Leonard Wood

# SUSTAINABLE MATERIALS & SYSTEMS

## OPPORTUNITIES

- Building Cladding Systems
- Lumber / Timbers; Structural Syste
- Building Insulation
- Floor & Wall Coverings; Paints
- Concrete & Asphalt
- Masonry Products
- Outdoor Furniture and Landscaping

Recycled-plastic lumber picnic ta

## BARRIERS

- Designers Unaware Of Opportunities
- Unknown Performance / Durability
- Lack Of Performance Based Specifications
- Lack Of Service History

Demonstration of Recycled-Plastic RR ties at Crane NSWC

## SUSTAINABLE MATERIALS & SYSTEMS

# RECYCLED-PLASTIC LUMBER

**8 billion pounds of plastic containers made each year**

**And the majority are landfilled!**

**US Army Corps of Engineers**

**Engineer Research & Development Center**

## SUSTAINABLE MATERIALS & SYSTEMS

# RECYCLED-PLASTIC LUMBER

- **Recent Effort**:
  - GBCUP to develop new CEGS and Technical Instructions for Use of Plastic Lumber Materials
  - Status:  uncompleted due to funding cuts

- **Research Needs**:
  - Guidance re: heavy bolted connections
  - Slip resistance
  - Arch design structures
  - Additional demos

## SUSTAINABLE MATERIALS & SYSTEMS

# RECYCLED-PLASTIC RR TIES

- Army has 2,100 miles of track; estimated 12,000 turnouts
- U.S. railroads replace 10-15 million RR ties each year!
- Plastic ties resistant to insects and rot

## SUSTAINABLE MATERIALS & SYSTEMS

# RECYCLED-PLASTIC RR TIES

- **Recent/Current Efforts**:
  - EPA funded project to assess effects on global warming -- use of waste plastics
  - Adding section in CEGS on Railroads

- **Research Needs**:
  - Fastener holding power
  - Lateral stability
  - Long-term performance / creep / stress-relaxation

(Anticipate some funds from FRA to help with above research needs.)

## SUSTAINABLE MATERIALS & SYSTEMS

# STRUCTURAL INSULATED SANDWICH PANELS

- Very high energy efficiencies
- Higher materials costs but lower construction costs
- Lower life-cycle costs

## SUSTAINABLE MATERIALS & SYSTEMS

# STRUCTURAL INSULATED SANDWICH PANELS

- **Recent Efforts**:
  - Developed draft CEGS and Technical Instructions for use of SIPS

- **Research Needs**:
  - Demonstration Project to validate benefits to Army

# Materials Based Sustainability Improvement Opportunities

## RECYCLED PLASTIC ROOFING

- 5 commercial sources
- Reply info. from 3 (sum. spread sheet)
- Inspection trip report (at 5 yrs service)
- 42 sq.+ purchased for Ft. Stewart
- (42 @$175 + ridge tiles + geosill sealant Total: $ 9,852)
- None c
job…
- With w
yet)

100% Recycled Content Roofing

Mixed with wood fiber (scale = 1m)

## Eco-Shake after 5 years of service:

- Huntsville, AL
- Slope 12-in-12
- Replaced wood (fungal growth)
- Underlayment installed “both” ways
- Some discoloration
- Shaded most of the day

# Materials Based Sustainability Improvement Opportunities

## "Green" Concrete

– Cement in concrete is a high energy material

– Production of cement releases excessive quantities of $CO_2$ into the atmosphere

– Use of fly ash in mix reduces cement and water needed

– Less water leads to higher strength, but requires a longer curing time

– Hydration of Portland cement during curing generates heat that can lead to thermal stresses and cracking – less cement means less heat

– Placeability of fly ash mix is comparable to conventional mixes at 70° F

– Fin[illegible]pother

Test samples for crush testing.

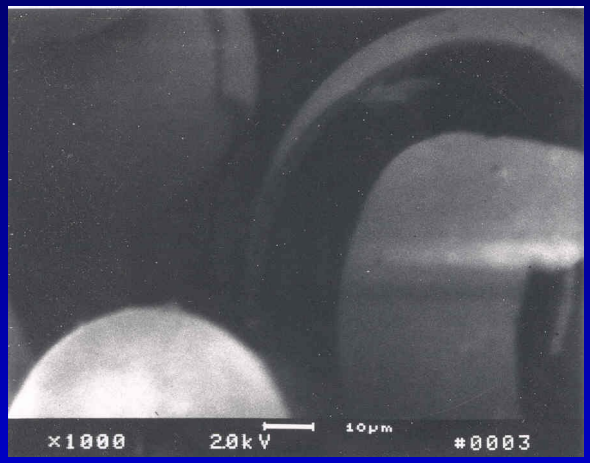
ASTM Class B fly ash.

# Materials Based Sustainability Improvement Opportunities

## INSULATING (?) ADDITIVES FOR PAINT

- Hollow ceramic microspheres
- "trapped air" basis of insulation
- Little/no test results available (ASTM)
- Simple Test: comparable loading with solid glass beads (very fine blast media) and a control
- Measure steady state surface temperature when exposed to heated

Glass beads, control, Insulad + coated test metal samples




SEM of microspheres (broken sphere shows 3.8 micron wall thickness)

# Soy Oil Based Polymer Resins

- The Composite Polymers Division of Ashland Specialty Chemical Company, a division of Ashland, Inc., in Dublin, Ohio, introduced its ENVIREZ® 5000, a resin made from soybean and corn oils.
  - The resin contains 25 percent renewable resources.
  - The new resin is typically used in sheet-molding-compound (SMC) applications in the compression molding market. Currently, Jo
    SMC resin to manufacture ex
    combines.
- Potential Uses
  - Adhesives
  - Coatings
  - Printing inks
  - Lubricants
  - Plastics and specialty products

# Synthetic Wood

- Biofibers, natural lignocellulosics, have an outstanding potential as a reinforcement in thermoplastics.
- Biofiber panels as a substitute for particle board using wheat, sunflower seed hulls, and soy bean fibers
- Applications:
  - Furniture
  - Cabinetry
  - Door Cores
  - Kitchen Countertops
  - Partitions
  - Stair Treads
  - Shelving
  - Underlayment

# Plant Fiber Reinforcing for Composites and Concrete

- Instead of steel bars or glass fiber, use hemp, sisal, coconut fiber, flax, cotton and bamboo for reinforcing
- In general, these plants possess the following benefits:
  - High tensile strength
  - High specific strength, i.e. strength to weight ratio
- Overall Limitations:
  - Relatively high absorption of moisture in core portion
  - Diminished board propert when using core for particleboard.

# Recycled Carpet

USING POST-CONSUMER PLASTICS

- Superior stain resistance
- Permanently static resistant
- Low moisture absorption
- Resists fading
- Superior strength and abrasion resistance

Conveyor carrying carpet

Carpet Sample

-Five billion pounds of carpet are disposed of each year

-Instead, this could be reused with recycled carpet

-Note: PET is “one use” and not recommended for high traffic areas, but Nylon can be recycled multiple times

-PWTB 420-49-X “Recycling Interior Finish Materials: Carpet and Ceiling Tiles”

# RASTRA

## Styrofoam construction blocks impregnated with concrete

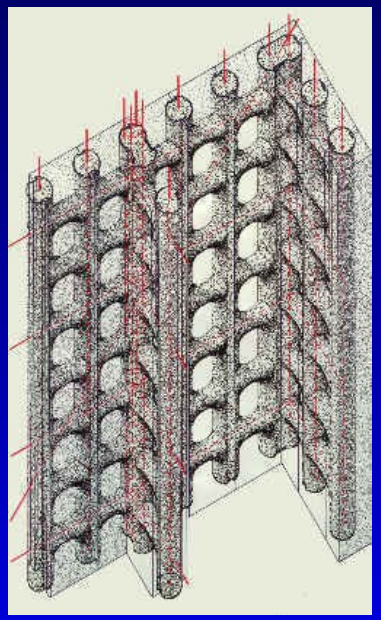
-Properties include, excellent insulation, fire-protection, soundproofing, and ease of installation.

- No cranes required for construction

- The result is a very strong house that reflects the high value of solid construction

Concrete filling Process

A completed house using RASTRA



Forming Matrix

# Basalt Fiber Reinforcement for Composites

- Basalt products
  - have no toxic re-action with air or water
  - are non-combustible and explosion proof
  - When in contact with other chemicals they produce no chemical reactions that may damage health or the environment
- Basalt has three times the heat insulation properties of asbestos.
- The life of basalt fiber pipes, is at least 50 years without maintenance or electrical or technical protection.
- Basalt fibers together with carbon or ceramic fibers can develop new hybrid composite materials and technologies.

# Barnacle Cement and Glue

- Barnacle cement may be a great construction adhesive
- A layer of this cement three ten-thousandths of an inch thick over one square inch will support a weight of 7000 pounds
- At temperatures above 6000°F the glue will soften but not melt
- At 380°F the cement will not crack
- It does not dissolve in most strong acids, alkalies, organic solvents, or water.

# Silk Hybrid Polymers

- The silk hybrid polymers could have some potential in anti-terrorism strengthening due to it's elasticity and strength
  - Cornel University is poised to explore applications for a hybrid silk
- Early applications
  - Textiles, where elasticity and strength are required

# RECOMMENDED ACTIONS

- **Continue “Greening” Guide Specifications (GBCUP)**
- **Conduct Awareness Training For Field Engineers**
- **Develop Affirmative Procurement Program Initiatives**
- **Conduct Demonstration Projects**
  - Large-Scale -- Model Building(s)
  - Small-Scale - Demos of Individual Technologies
- **Tools For Materials Selection Decision Making**
- **Conduct Performance Evaluations**
  - Determine Durability
  - Assess True Cost Benefits
- **Partner With Industry / Academic Developers**